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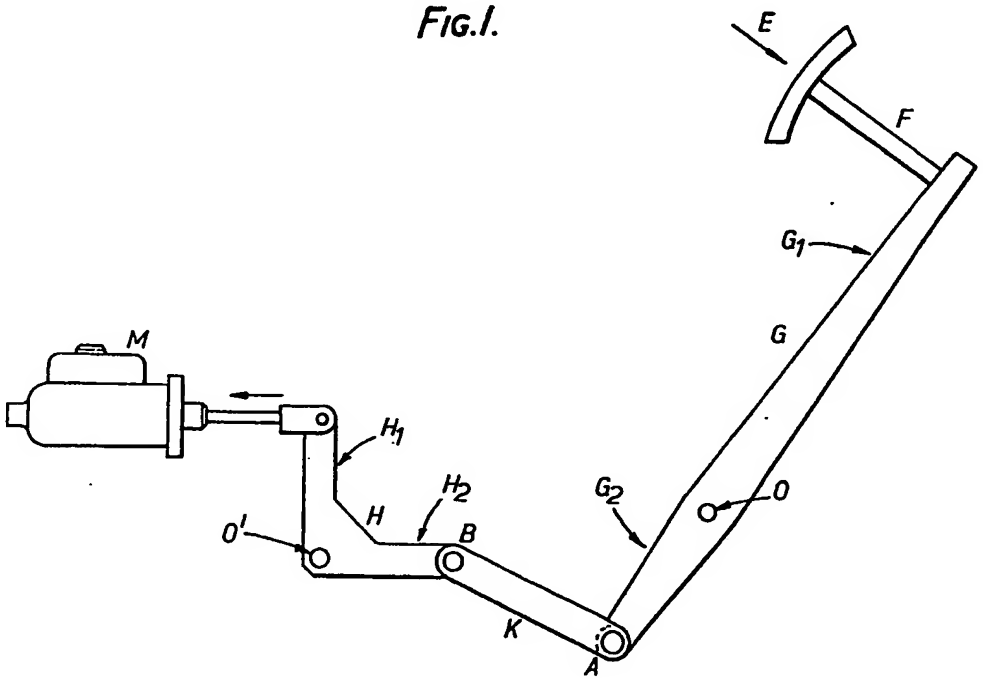
(54) Pedal mechanism for hydraulic brake systems

(57) A pedal mechanism for actuating a master cylinder (M) of an hydraulic braking system comprises a pedal lever (G) with a fixed pivot (O) and to one end of which the braking effort (E) is applied, a bell crank lever (H) coupled to the master cylinder (M), and a link rod (K) interconnecting the pedal and bell crank levers for transmitting the braking effort (E) to the master cylinder and increasing the pedal ratio of the mechanism as the pedal lever (G) pivots under the action of the braking effort (E).

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

FIG. 1.



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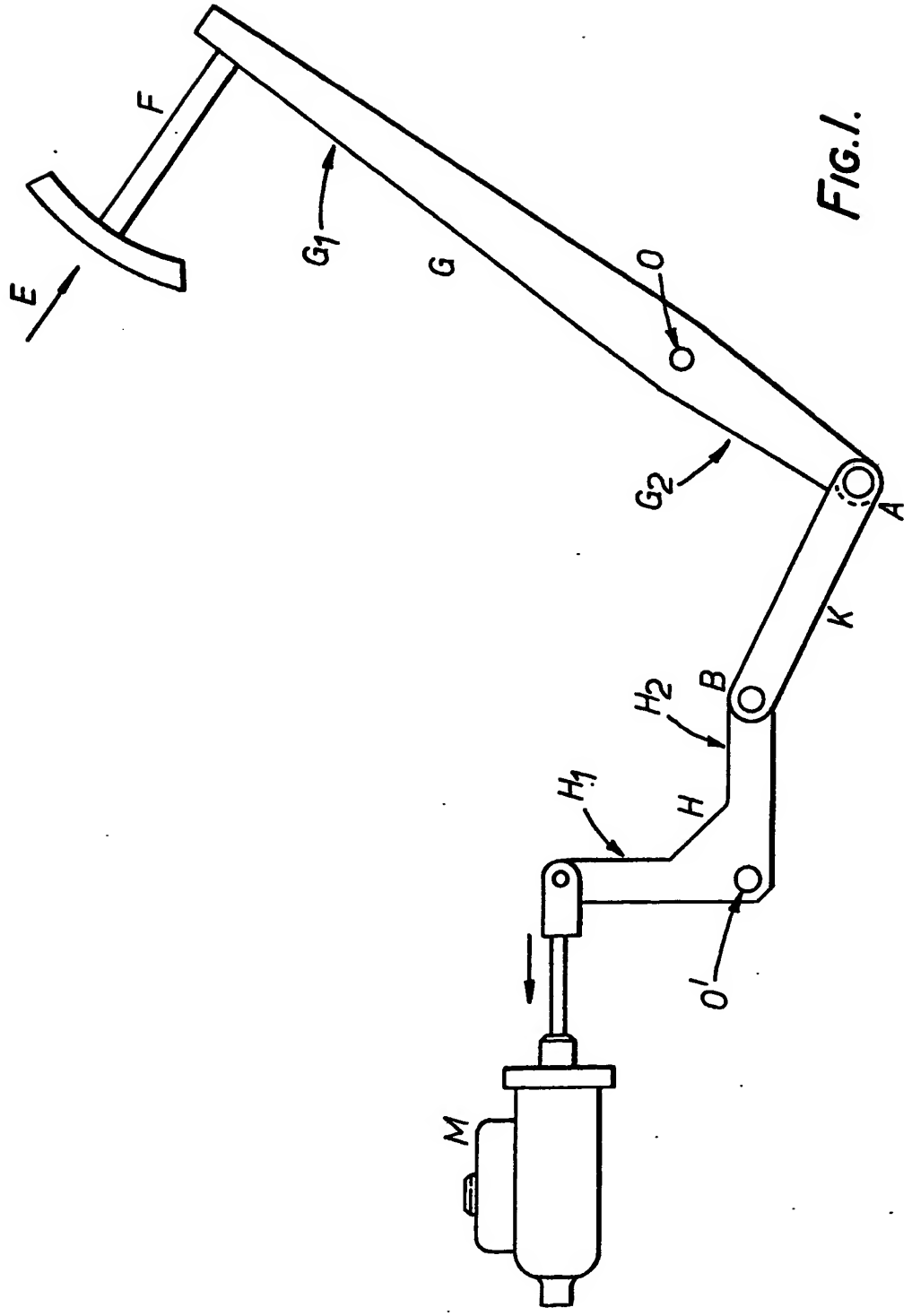

FIG.1.

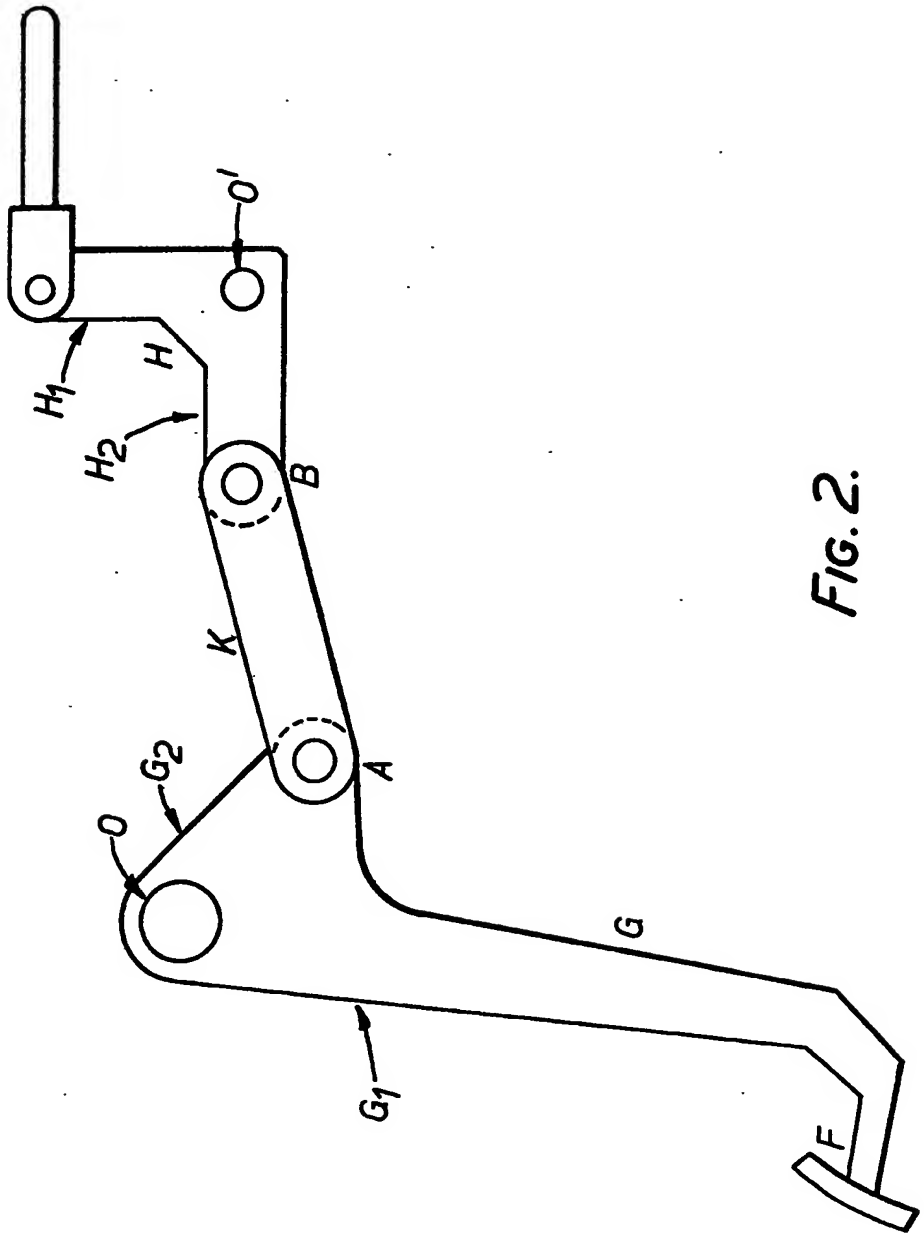

FIG. 2.

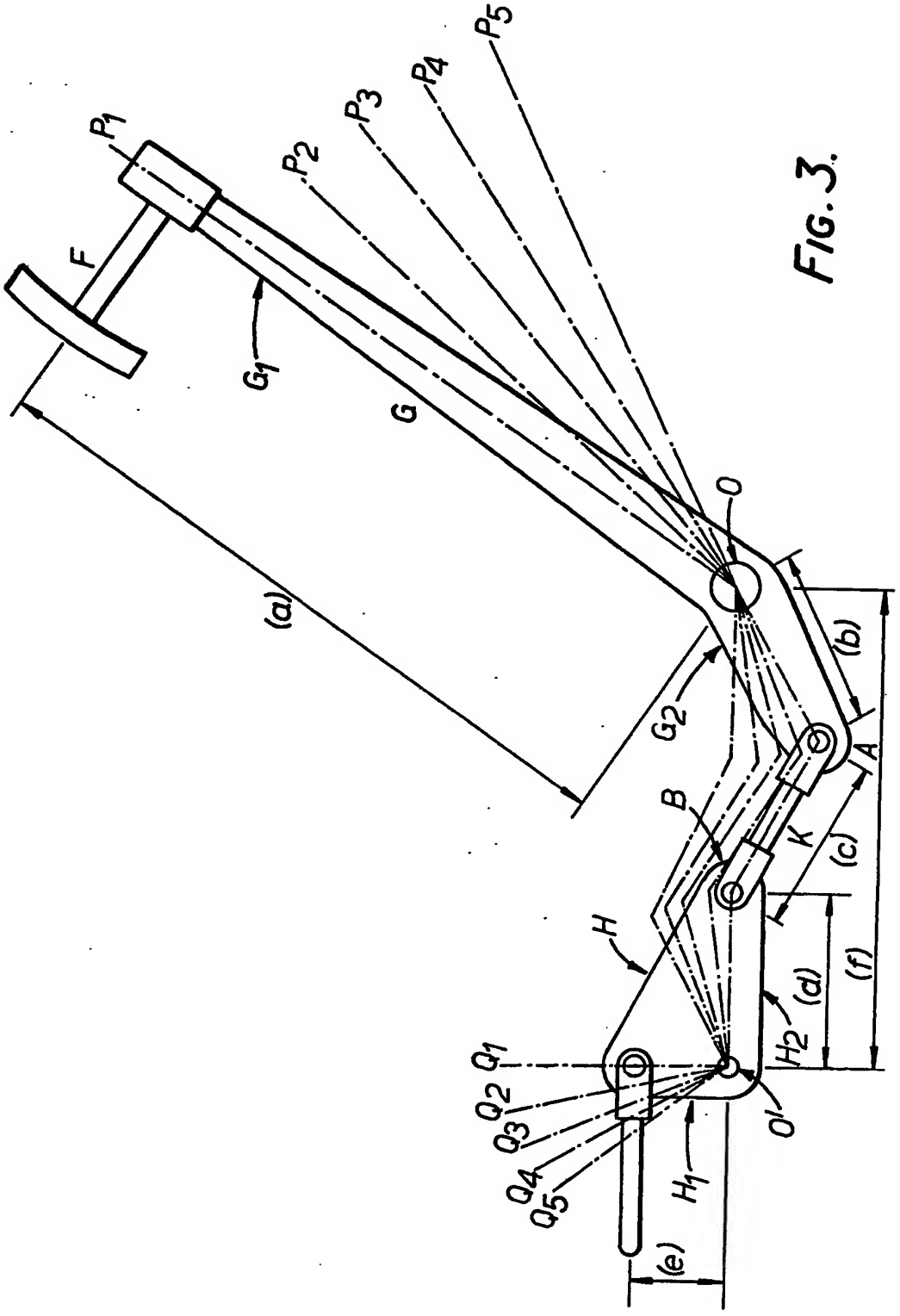

FIG. 3.

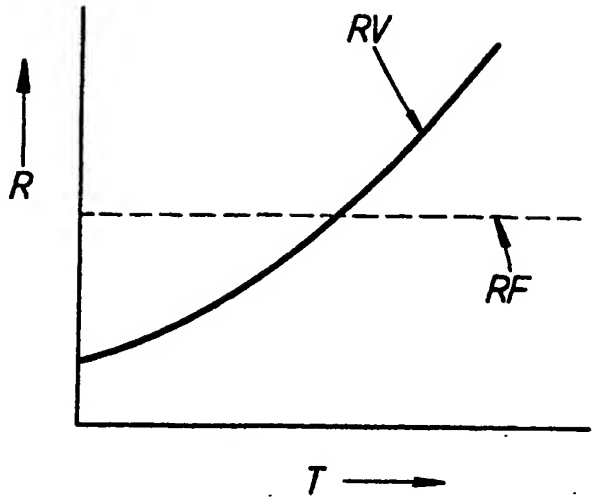

FIG. 4.

FIG. 5.

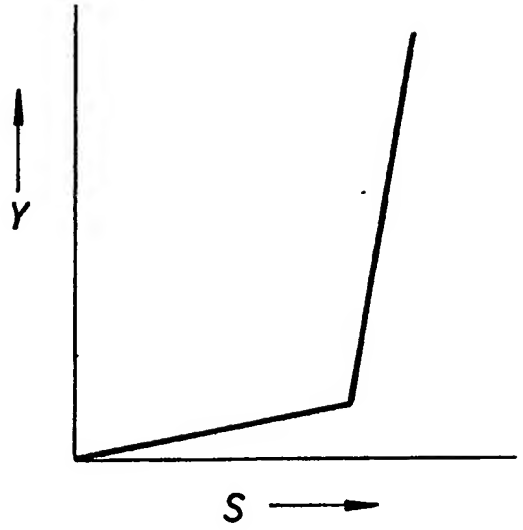

FIG. 6.

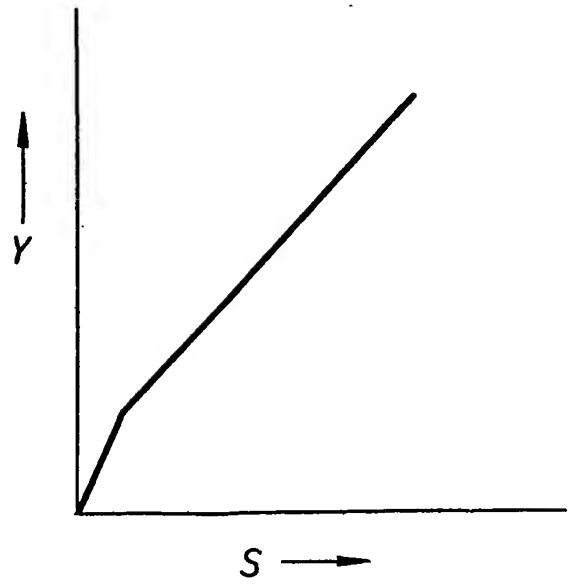

FIG. 7.

SPECIFICATION

Pedal mechanism for hydraulic brake systems

This invention relates to a hydraulic brake system, and more particularly to a pedal mechanism for such a system having a variable pedal ratio.

The pedal ratio of a pedal mechanism represents the mechanical advantage of the brake pedal lever; in other words, it is the ratio between the output effort at the push-rod of a master cylinder of the braking system, and the corresponding input impulse or human effort at the brake pedal.

In most known pedal mechanisms, the brake pedal actuating the master cylinder is assigned a fixed ratio which multiplies the input impulse or human effort at the brake pedal for conversion to an adequate hydraulic thrust at the master cylinder.

In the operation of an hydraulic brake system, the actuation of the master cylinder piston is initially intended to displace the fluid in the master cylinder to the wheel cylinders for taking up mechanical clearance; accordingly, during this stage of travel of the piston, a low pedal ratio would suffice. Once, however, such mechanical clearance is taken up, higher pressures in the master cylinder are necessitated in the next stage during further travel of the piston or human effort at the brake pedal. It is to reduce such impulse or effort at the brake pedal to comfortable levels, that a correspondingly higher pedal ratio is desirable.

According to the present invention there is provided a pedal mechanism for an hydraulic braking system, comprising a pedal lever pivotable about a fixed axis and including a first arm to which a braking effort is applied in use of the mechanism and a second arm, a bell crank lever pivotable about a fixed axis and having a first arm for actuating a master cylinder of the braking system and a second arm, and a member interconnecting and pivoted to the second arms of the pedal and bell crank levers whereby, in use, applying a braking effort to the first arm of the pedal lever causes actuation of the master cylinder, and the pedal ratio of the mechanism increases with the pivoting of the pedal lever under the action of the applied effort.

With such a pedal mechanism an appropriate variable pedal ratio is obtainable that is to say, a low pedal ratio which is sufficient for the purpose of the initial travel of the master cylinder piston and corresponding low pressure demand in the master cylinder; and a succeeding, progressively increasing pedal ratio during the further travel of the piston to correspond to the progressively increasing pressure demand in the master cylinder, whereby the input impulse or human effort at the brake pedal is maintained at comfortable levels throughout the brake operation, i.e., not only during the initial travel of the piston in the master cylinder when the pressure demand therein is low, but also during the further travel of the piston when the pressure demand rises appreciably. Another advantage is that higher deceleration levels can be achieved and, furthermore, friction linings having a low coefficient of friction may be used without detracting from the overall performance of the braking system.

A better understanding of the invention will be had from the following detailed description which is given with reference to the accompanying drawings in which:—

Figure 1 schematically illustrates one possible pedal mechanism embodying the invention;

Figure 2 schematically illustrates another pedal mechanism embodying the invention;

Figure 3 schematically illustrates a slightly modified form of the pedal mechanism of Figure 1, and shows the different positions during brake operation;

Figure 4 is a graph showing master cylinder piston travel T plotted against the pedal ratio R, for braking systems having pedal mechanisms with a fixed pedal ratio and a variable pedal ratio according to the invention;

Figure 5 is a graph showing the master cylinder piston travel T plotted against the hydraulic pressure Y within the master cylinder;

Figure 6 is a graph showing the pedal travel S plotted against the hydraulic pressure Y within the master cylinder for a braking system having a pedal mechanism with a fixed pedal ratio; and

Figure 7 is a graph showing the pedal travel S plotted against the hydraulic pressure Y within the master cylinder for a braking system having a pedal mechanism according to the invention.

In the pedal mechanism illustrated in Figure 1 a master cylinder M will be actuated by one arm H_1 f a bell crank lever H whenever an input impulse or human effort E applied at the brake pedal F is transmitted to one arm G_1 of the cooperating brake pedal lever G. The bell crank lever H and the brake pedal lever G are rigidly pivoted at O' and O respectively.

In the known pedal mechanism having a fixed pedal ratio the two arms H_2 and G_2 of the bell crank lever H and the brake pedal lever G would be connected directly together at their ends B and A. In the pedal mechanism illustrated, however, an intermediate member K is disposed b tw en, and movably pivoted to, the said two arms H_2 and G_2 at B and A, resp ctiv ly, wh reby th input impulse or human effort E applied at the pedal F is transmitted by th brake pedal lever G, through the int rmediate member K, to the bell crank lever H and thence to the piston rod of the master cylinder M. The member K forms a "floating link" b tween the brak pedal l ver G and the bell crank lever H to furnish a variable pedal ratio, as will b come clear from th description of Figure 3.

In practical applications the l ngths OA, AB, O'B, O'C and other parameters of the system are dependent upon the specific v hicle und r consid ration and th variable pedal ratio obtainable may

range from 2:1 to 14:1.

The embodiment illustrated in Figure 2 of the drawings corresponds to the pendent type pedal arrangement. The various components of the pedal mechanism are identified by the same reference letters as the corresponding parts in Figure 1. The operation is essentially the same as that of the embodiment illustrated in Figure 1 of the drawings, and further description of the Figure 2 construction should not be necessary.

Figure 3 of the drawings illustrates a pedal mechanism which is substantially the same as the embodiment in Figure 1. The slight modifications will be apparent from the drawings, in which corresponding parts are identified by the same reference letters in Figures 1 and 3. For various positions P_1 to P_5 of the brake pedal lever G, the corresponding positions of the intermediate member K and positions Q_1 to Q_5 of the bell crank lever H, are depicted. For the following specific dimensions *a*—*f* as indicated in Figure 3, the pedal ratio for each of the illustrated pedal positions is a shown in the table below.

a	=	354 mm
b	=	86 mm
c	=	87 mm
d	=	88 mm
e	=	50 mm
f	=	240 mm

Pedal position	Pedal ratio
P_1	3.91
P_2	5.96
P_3	7.56
P_4	9.25
P_5	12.03

From the above table it can be seen that the pedal ratio increases with the pedal travel, which is also shown in Figure 4.

From the graph of Figure 4 in which the pedal ratio R is plotted against the pedal travel T it can be seen that for a fixed pedal ratio as used in the prior art the pedal ratio RF remains constant, whereas with a pedal mechanism according to the present invention the pedal ratio RV increases at a gradually increasing rate as the pedal travel increases.

The graph of Figure 5 illustrates the relationship between the pressure Y in a master cylinder and the travel T of the master cylinder piston. The pressure increases slowly until all the mechanical clearances in the braking system have been taken up, after which the pressure increases rapidly with further piston displacement. Larger forces are then necessary to produce a further increment of the piston travel for which reason a pedal mechanism with a variable pedal ratio according to the invention is of advantage.

Referring now to Figure 6 in which the master cylinder pressure is plotted against pedal travel T for a pedal mechanism with a fixed pedal ratio, as is to be expected the curve follows essentially the same bent path as that of Figure 5. In contrast, the corresponding curve, plotted in Figure 7, for a pedal mechanism in accordance with the invention is much less severely bent and increases almost linearly throughout the full rang of p dal m v ment.

CLAIMS

1. A p dal mechanism for an hydraulic braking system, comprising a pedal l v r pivotable about a fix d axis and including a first arm t which a braking ffort is applied in us of the m chanism and a second arm, a bell crank lever pivotabl about a fix d axis and having a first arm for actuating a mast r

cylinder of the braking system and a second arm, and a member interconnecting and pivoted to the seconds arms of the pedal and bell crank levers whereby, in use, applying a braking effort to the first arm of the pedal lever causes actuation of the master cylinder, and the pedal ratio of the mechanism increases with the pivoting of the pedal lever under the action of the applied effort.

2. A pedal mechanism according to claim 1 wherein said member comprises a rectilinear, rigid rod.

3. A pedal mechanism substantially as herein described with reference to Figures 1 to 4 and 7 of the accompanying drawings.

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